Record high T_c ~ 570 K and saturation magnetization enhancement in 2D $Fe_{5-\delta}GeTe_2$ /Bi_2Te_3 heterostructures grown by MBE

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Two-dimensional (2D) van der Waals (vdW) metallic ferromagnets Fe_xGeTe_2 (x = 3 – 5) are promising candidates for spintronics [1], [2] as well as for fundamental physics studies since they are found to possess skyrmions and topological nodal lines with high anomalous Hall current [3]. Thin films of Fe_5GeTe_2 have been grown by Molecular Beam Epitaxy (MBE) with a T_c close to room temperature (RT) [4]. In the present work [5], ferromagnetic $Fe_{5-\delta}GeTe_2$/Bi_2Te_3 topological insulator (TI) heterostructures were grown by MBE on insulating substrates and they have been compared to bare $Fe_{5-\delta}GeTe_2$ films. In situ RHEED and ex-situ XRD confirm the x = 5-δ phase indicating good epitaxial quality of the films. The magnetic properties were investigated using Magneto-optical Kerr (MOKE) microscopy/magnetometry and SQUID magnetometry. The main result is that the growth of Bi_2Te_3 TI on $Fe_{5-\delta}GeTe_2$ films significantly enhances both, the in-plane saturation magnetization and the T_c well above room temperature reaching a record value of 570 K. First principles calculations, indicate that the proximity of Bi_2Te_3 to $Fe_{5-\delta}GeTe_2$ increases the density of states at the Fermi level and/or induces tensile strain which stabilizes a high magnetic moment phase which could explain the observed enhancement of ferromagnetism. In ferromagnetic resonance measurements, a large spin mixing conductance is observed in $Fe_{5-\delta}GeTe_2$/Bi_2Te_3 system, suggesting that this heterostructure could be suitable to exploit spin to charge conversion in spintronic devices at room temperature.

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References

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Figures

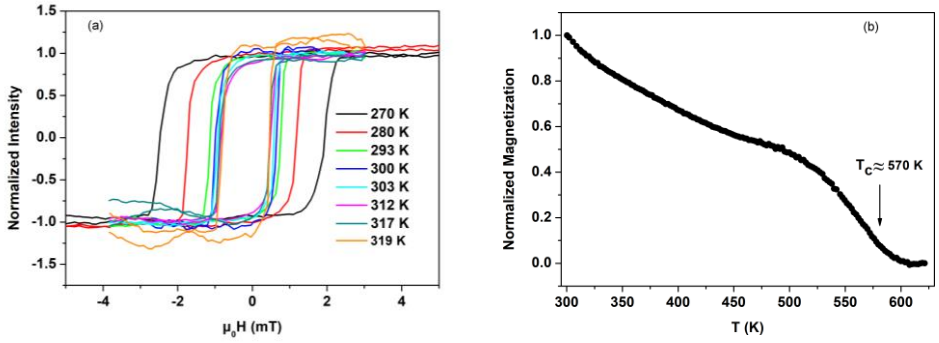

Figure 1: (a) MOKE hysteresis loops and (b) Temperature dependence of the Normalized magnetization for $Fe_{5-\delta}GeTe_2$/Bi_2Te_3 heterostructures